INCH-POUND

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DETAIL SPECIFICATION

EXPANSION JOINTS, PIPE, METALLIC BELLOWS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

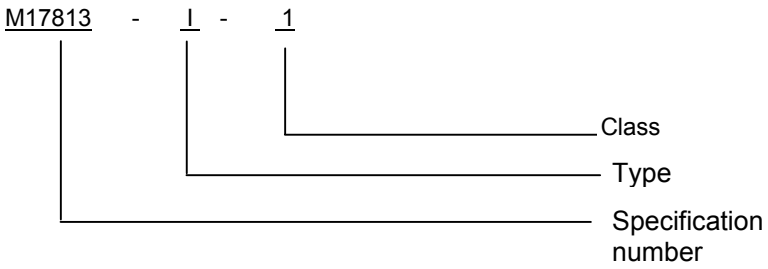
1.1 Scope. This specification covers metallic bellows expansion joints used to absorb dimensional movement in piping systems. This movement may be caused by thermal expansion, contraction, or adjacent-t structural movements.

1.2 Classification. The expansion joints are of the following types and classes as specified (see 6.2).

Type I	-	Corrugated bellows, unreinforced.
Type II	-	Corrugated bellows, reinforced.
Type III	-	Fabricated bellows.
Class 1	-	Single bellows expansion joint.
Class 2	-	Double bellows expansion joint.
Class 3	-	Pressure balanced expansion joint.
Class 4	-	Externally pressurized single or double expansion joint.

Note: Not every class applies to every type of expansion joint.

1.3 Part or Identifying Number (PIN). PIN's to be used for metallic bellows, expansion joint pipes acquired to this specification are created as follows:



Comments, suggestions, or questions on this document should be addressed to: Commander, Defense Supply Center Columbus, Attn: VAI, 3990 East Broad Street, Columbus, Ohio, 43216-5000 or emailed to Construction@dscc.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://www.dodssp.daps.mil.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4 or 5 of this specification. This section does not include documents cited in other of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4 or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are cited in the solicitation or contract.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.5	-	Steel Pipe Flanges and Flanged Fittings
ASME B31.1	-	Piping, Power
ASME	-	ASME Boiler and Pressure Vessel Code

(Copies of these documents are available online at http://www.asme.org or from the ASME Information Central Orders/Inquiries, P.O. Box 2300, Fairfield, NJ 07007-2300.)

ASTM INTERNATIONAL

ASTM A240/A240M	-	Heat Resisting Chromium and (Chromium Nickel Stainless Steel) Plate, Sheet and Strip for Fusion Welded Unfired Pressure Vessels
ASTM B36/B36M	-	Brass Plate, Sheet Strip and Rolled Bar
ASTM B103/B103M	-	Plate Phosphor Bronze, Sheet, Strip and Rolled Bar
ASTM B127	-	Nickel-Copper Alloy Plate, Sheet and Strip
ASTM B152/B152M	-	Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B168	-	Nickel-Chromium-Iron Alloys, and Nickel-Chromium-Cobalt-Molybdenum Alloy Plate, Sheet, and Strip
ASTM B194	-	Copper-Beryllium Alloy Plate, Sheet, Strip and Rolled Bar
ASTM B409	-	Nickel-Iron-Chromium Alloy Plate, Sheet and Strip
ASTM B424	-	Plate, Sheet, and Strip, NI-FE-CR-MO-CU Alloy
ASTM B443	-	Plate, Sheet, and Strip, Nickel-Chromium-Molybdenum-Columbium Alloy
ASTM E709	-	Examination, Magnetic Particle

(Copies of these documents are available from http://www.astm.org or ASTM International, P.O. Box C700, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

EXPANSION JOINT MANUFACTURER ASSOCIATION, INC. (EJMA)

Standards of the Expansion Joint Manufacturers Association

(Copies of these documents are available from http://www.ejma.org or to the Expansion Joint Manufacturers Association, 25 North Broadway, Tarrytown, NY 10591.)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 10012-1	-	Quality Assurance Requirements for Measurement Equipment / Metrological Confirmation System for Measuring Equipment

(Copies of these documents are available from http://www.iso.ch or International Organization for Standardization American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036.)

NATIONAL CONFERENCE OF STANDARDS LABORATORIES (NCLS)

NCSL Z540-1	-	General Requirements for Calibration Laboratories and Measuring and Test Equipment (DoD-adopted)

(Copies of these documents are available from http://www.ncsli.org or to National Conference of Standards Laboratories (NCSL), 2995 Wilderness Place, Suite 107, Boulder, CO 80301-5404.)

2.4 Order of precedence. In event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Standard commercial product. The expansion joint shall, as a minimum, be in accordance with the requirements of this specification and shall be the manufacturer's standard commercial product. Additional or better features which are not specifically prohibited by this specification but which are a part of the manufacturer's standard commercial product, shall be included in the expansion joint being furnished. A standard commercial product is a product, which has been sold or is being currently offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures, and represents the latest production model.

3.2 First article. When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with see 4.1.

3.2.1 Determination of movement. In determining the qualifying rated contraction or extension, consideration shall be given to the equivalent axial movement due to lateral deflection and angular rotation. Equivalent axial movement shall be added to the actual specified values of axial movement and shall be computed in accordance with the EJMA standards.

3.2.2 Universal, swing, and pressure-balanced expansion joints. Universal, swing, and pressure-balanced expansion joints consist of two or more bellows connected by pipe sections or fittings. Since it is not the intent of the specification to test these units as assemblies, only one prototype bellows is required to qualify any such combination of bellows.

3.3 Materials. Materials used shall be free from defects, which would adversely affect the performance or maintainability of individual components, or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all equipment, material, and articles incorporated in the work covered by this specification are to be new and fabricated using materials produced from recovered materials.

3.3.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3.2 Pipe and bellows materials. Material for the bellows shall be one or more of the following:

a. ASTM A240/A240M	-	Types 304, 304L, 310, 316, 316L, 321, 347, or 348.
b. ASTM B36/B36M	-	70/30 Brass (UNS C26000).
c. ASTM B103/B103M	-	Grade A Phosphor Bronze (UNS C51100).
d. ASTM B127	-	Class A Nickel Copper Alloy.
e. ASTM B152/B152M	-	UNS C11000, C11300, C11400, C11600, C12000, C12200, C12300, C12500, or C14200.
f. ASTM B168	-	Nickel-Chromium-Iron Alloy.
g. ASTM B194	-	Beryllium Copper.
h. ASTM B409	-	Nickel-Iron-Chromium Alloy.
i. ASTM B424	-	Nickel-Iron-Chromium-Molybdenum-Copper Alloy.
j. ASTM B443	-	Nickel-Columbium-Molybdenum Alloy.

Material not definitely specified shall be of the quality used for the purpose in commercial practice (see 6.2).

3.4 Description. A bellows expansion joint shall consist of one or more bellows with suitable connections and accessories, as required, by the application. Terminology utilized in this specification is that used in the EJMA Standards.

3.4.1 Interchangeability. All joints of the same classification furnished with similar options under a specific contract shall be identical to the extent necessary to ensure interchangeability of component parts, assemblies, accessories, and spare parts.

3.4.2 Types.

3.4.2.1 Type I. Type I expansion joints shall have bellows formed in accordance with 3.6.1.

3.4.2.2 Type II. Type II expansion joints shall meet the requirements of type I, and where required by 1.2 shall be provided with reinforcing rings or equalizing rings as described in 3.6.11.

3.4.2.3 Type III. Type III expansion joints shall have fabricated bellows of disk or diaphragm construction.

3.4.3 Classes.

3.4.3.1 Class 1. Class 1 expansion joints shall have a single bellows.

3.4.3.2 Class 2. Class 2 expansion joints shall have two bellows separated by a section of pipe.

3.4.3.3 Class 3. Class 3 expansion joints shall be a pressure-balanced joint in which the pressure thrust of the line bellows is offset by the effect of a balancing bellows.

3.4.3.4 Class 4. Class 4 expansion joints shall be of the externally pressurized variety either single or double bellows.

3.5 Performance.

3.5.1 Movement. The expansion joint shall be capable of absorbing the normal operating movement, such as axial, lateral, angular, or a combination of these movements as specified (see 6.2 and 6.3).

3.5.1.1 Additional movement. When specified (see 6.2), the expansion joint shall be physically capable of absorbing an additional movement in an amount up to the rated movement of the joint (see 6.3b). This movement can be installation tolerances or upset conditions; the nature of this movement must be specified (see 6.2).

3.5.1.2 Cycle life expectancy. The capacity of the expansion joint to withstand the number of cycles specified shall be determined in accordance with the EJMA standards, a history of successful operation of similar bellows, or by a qualification test, and shall be specified (see 6.2). The manufacturer shall certify compliance with these requirements.

3.5.2 Deflection force. The force required to deflect the expansion joint shall be equal to or less than the force specified (see 6.2). The connecting piping shall be properly guided and anchored in accordance with the EJMA standards.

3.5.3 Expansion joint stability. The expansion joint shall be designed as to preclude instability when the joint is subjected to the specified operating or test condition. Instability shall be as defined in the EJMA standards.

3.6 Construction. The expansion joints covered by this specification shall be designed and constructed in accordance with the generally accepted engineering principles set in ASME B31.1, or section VIII, division 1, of the ASME Boiler and Pressure Vessel Code, and/or the EJMA standards.

3.6.1 Corrugated bellows. Corrugated bellows for types I and II expansion joints shall be formed by one of the methods described in the EJMA standards. Sizes up to and including 10 inches shall be formed from seamless tubing or from a tube having only a longitudinal welded seam. For sizes larger than 10 inches, more than one longitudinal welded seam is permissible. In no case will circumferential seams be accepted on formed corrugated bellows unless the requirements of a particular application require construction and the design is approved by the procuring organization. Corrugations shall be symmetrical and of similar dimensions.

3.6.2 Fabricated bellows. Fabricated bellows for type III expansion joints shall be constructed of single-formed diaphragms joined together with circumferential seams at the inner and outer perimeters of the diaphragms, or constructed of single formed corrugations joined together with circumferential seams of the inner perimeters of the corrugations.

3.6.3 Externally guided bellows. The bellows in class 4 expansion joints shall be designed and manufactured in accordance with the EJMA standards. Sizes up to and including 10 inches shall be formed from seamless tubing or from a tube having only one longitudinal welded seam. For sizes larger than 10 inches, more than one longitudinal seam is permissible. In no case will circumferential seams be accepted unless the requirements of a particular application require such construction and the design is approved by the agency concerned. Convolutions shall be symmetrical and of similar dimensions.

3.6.4 End connections. The connecting ends of the joints shall be provided with pipe flanges or welded nipples as specified (see 6.2). Flange dimensions shall conform to the diameter and drilling of ASME B16.5. The size, material, and pressure class shall be as specified (see 6.2). Facing shall be as specified. Unless otherwise specified (see 6.2), the manufacturer may furnish "Van Stone" facings, made by turning or flaring the ends of the bellows over the flange face. The outside diameter of the Van Stone facing is to be the same as an equivalent lap stub end, or the raised face of the mating flange if different. The face of the Van Stone, however is not a machine finish and it may not comply in every respect with the ASME dimensions for a raised face. A lap joint stub end may be provided when necessary. Welding nipples shall be of a size, material, and nominal wall thickness designation specified, and shall be beveled for welding.

3.6.5 Limit stops. When required for proper operation (see 6.2), limit stops shall be provided and arranged to limit the movement of the joint to that for which it is designed.

3.6.6 System alignment. Piping adjacent to the expansion joint shall be properly aligned and guided so that the expansion joint is subjected to only those movements for which it is designed. Type II joints designed for the absorption of axial movement shall, when required, be provided with suitable tie-rods, guide sleeves, or covers to prevent distortion of the expansion joint by weight of the reinforcement hardware. On a universal expansion joint incorporating tie-rods, the rods may be used to support the weight of the center section. Joints aligned by internal guides shall have suitable means provided to prevent excessive annular pressure between the guide and the bellows. (Note: The use of internally or externally guided expansion joints does not eliminate the necessity of using adequate external pipe guides.)

3.6.7 Guiding. Expansion joints may have guides located both internally and externally or only internally to the chamber, as specified (see 6.2). Guides shall be integral with the body or rigidly attached to the tube. They shall be concentric with each other, with the body of the joint, and with the tube. Limit stops shall be furnished in accordance with the manufacturer's standard practice.

3.6.8 Flow liners. Flow liners and material for these liners shall be specified for all expansion joints, regardless of the metal of the bellows, in the following cases (see 6.2):

a. When friction losses should be held to a minimum and smooth flow is desired.
b. When flow velocities exceed those specified in the EJMA standards.
c. When there is a danger of pitting or erosion, as in lines carrying abrasive solid particles, heavy sleeves are required.
d. During high temperature service with an uninsulated bellows, when it is necessary to decrease the temperature of the bellows and enable the metal to retain its higher mechanical properties.
e. When copper alloy bellows are used for high pressure drip, or superheated steam, hot water, or condensate, or when there is any possibility of flashing.

When flow liners are used in vertical sections, drain holes shall be provided to prevent fluid or condensate accumulation. Flow liners should not be used when high viscosity fluids, such as tars, are being transmitted, since these fluids could accumulate and cause premature expansion joint failure. When the fluid is such that purging will effectively prevent accumulation, flow liners may be used in conjunction with purging connections. Flow liners should not be considered as substitutes for internal guides.

3.6.9 Base. When specified (see 6.2), class 4 expansion joints shall be provided with a base. The base for class 4 joints shall be designed primarily as a support for the joint and when specified, shall also be designed for use as a main anchor. All expected forces and moments for anchor bases must be specified. Class 2 expansion joints shall be with a base suitable as an intermediate anchor. (Note: An expansion joint that is used as an untied or tied universal should not have an anchor base.)

3.6.10 Drain connection. When specified (see 6.2), a drain connection shall be provided on the center pipe section of class 2 expansion joints and shall be threaded, flanged, or beveled for welding.

3.6.11 Rings. Type II expansion joints shall be provided with reinforcing or equalizing rings. Reinforcing rings, which support the root of the corrugation under internal pressure, are solid or tubular in cross section. Equalizing rings, which support the root and sidewalls of the corrugation under internal pressure are usually “T” shaped in cross section. Equalizing rings, sometimes called control rings, have diameters larger than the outside diameter of the corrugation and limit the maximum compression of each corrugation.

3.6.12 Shrouds. When specified (see 6.2), shrouds shall be provided which shall protect from external damage, prevent foreign material from falling between the corrugations of the bellows, and permit insulation of the expansion joint.

3.7 Bellows material.

3.7.1 Copper alloy bellows. Copper alloy bellows shall have their longitudinal seams joined by either welding or brazing operations. The bellows (except for those fabricated of diaphragms welded or brazed at inner and outer perimeters) shall be supplied in a stress relieved or annealed condition and shall be pickled to remove the heat treating scale. The maximum working pressure rating shall not exceed 25 pounds per square inch gage (psig) for type I joints or 200 psig for type II joints.

3.7.2 Corrosion-resistant steel bellows. Corrosion-resistant steel bellows shall have their longitudinal seams joined by welding. The bellows may be stress relieved or annealed at the discretion of the manufacturer. When some form of heat-treating is employed, the bellows shall be pickled to remove the resultant scale. (If iron or carbon steel forming tools are used with corrosion-resistant steel bellows, the bellows shall be passivated after forming.)

3.7.3 Other bellow materials. If materials other than those mentioned previously are used, the bellows shall be constructed in accordance with the manufacturer’s standard practice.

3.8 Drawings. A dimensional sketch or drawing in sufficient detail to describe the equipment, which the contractor proposes to furnish, shall be submitted to the agency concerned with the bid proposal (see 6.2). Such a drawing or sketch shall be accompanied by a copy of the manufacturer’s specification and rating data providing sufficient detail to signify compliance with the requirements of this specification.

3.9 Treatment and painting. Unless otherwise specified (see 6.2), the expansion joint shall be treated and painted in accordance with the manufacturer’s standard practice. All surfaces of the expansion joint other than corrosion-resisting steel shall be protected against corrosion and present a neat appearance.

3.10 Workmanship. Workmanship shall be in accordance with the best commercial practice for this type of product. All expansion joints shall be clean and free of burrs, cracks, pits, porosity, and other imperfections affecting serviceability of this product.

4. VERIFICATION

4.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

a. First article inspection (see 4.3).
b. Conformance inspection (see 4.5).

4.2 Cross-reference matrix. Table I provides a cross-reference matrix.

TABLE I. Cross-reference matrix.

Inspection	Requirement paragraph	Test paragraph
Standard commercial product	3.1	4.6
First article	3.2	4.1, 4.3, 4.6, 4.7
Determination of movement	3.2.1	4.6, 4.7
Universal, swing, and pressure-balanced expansion joints	3.2.2	4.6, 4.7
Materials	3.3	4.2.2, 4.6
Pipe and bellows materials	3.3.2	4.2.2, 4.6
Interchangeability	3.4.1	4.6
Type I	3.4.2.1	4.6
Type II	3.4.2.2	4.6
Type III	3.4.2.3	4.6
Class 1	3.4.3.1	4.6
Class 2	3.4.3.2	4.6
Class 3	3.4.3.3	4.6
Class 4	3.4.3.4	4.6
Movement	3.5.1	4.6, 4.7
Additional movement	3.5.1.1	4.6, 4.7
Cycle life expectancy	3.5.1.2	4.7.2
Deflection force	3.5.2	4.7.6b
Expansion joint stability	3.5.3	4.6
Construction	3.6	4.6
Corrugated bellows	3.6.1	4.6
Fabricated bellows	3.6.2	4.6
Externally guided bellows	3.6.3	4.6
End connections	3.6.4	4.6
Limit stops	3.6.5	4.6
System alignment	3.6.6	4.6
Guiding	3.6.7	4.6
Flow liners	3.6.8	4.6
Base	3.6.9	4.6
Drain connection	3.6.10	4.6
Rings	3.6.11	4.6
Shrouds	3.6.12	4.6
Copper alloy bellows	3.7.1	4.6
Corrosion-resistant steel bellows	3.7.2	4.6
Other bellow materials	3.7.3	4.6
Drawings	3.8	4.6
Treatment and painting	3.9	4.6
Workmanship	3.10	4.6

4.2.1 Calibration. Calibration of inspection equipment shall be in accordance with ISO-10012-1 and NCSL Z540-1.

4.2.2 Component and material inspection. Components and materials shall be inspected in accordance with all the requirements specified herein and in applicable documents.

4.3 First article inspection. First article inspection shall be performed on the expansion joint when a first article is required (see 3.2 and 6.2). This inspection shall include the examination of 4.6 and the tests of 4.7. The first article may be either a first production item or a standard production item from the supplier's current inventory provided it meets the requirements of the specification and is representative of the design, construction, and manufacturing technique applicable to the remaining items to be furnished under the contract.

4.4 Quality conformance inspection. The quality conformance inspection shall include the examination of 4.6, the tests of 4.7, and packaging inspection of 4.9. This inspection shall be performed on the samples selected in accordance with 4.5.1.

4.4.1 Failure. Failure of an article sample to pass any of the inspections specified herein shall be cause for the Government to refuse to accept further products until corrective action has been made and successful completion of first article testing accomplished.

4.5 Conformance inspection.

4.5.1 Sampling. Every expansion joint shall be examined as specified in 4.6. Sampling for tests specified in 4.7 and packaging inspection of 4.9 shall be as agreed upon by the contracting agency and the contractor.

4.6 Examination. Each expansion joint shall be examined for compliance with the requirements specified in section 3 of this document. Any redesign or modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following failure to meet specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Noncompliance with any specified requirements or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection.

4.7 Tests. The following tests shall be performed. Failure of any joint to pass any specified test shall be cause for rejection.

4.7.1 Hydrostatic test. Each joint shall be subjected to a hydrostatic pressure equal to the maximum test pressure specified.

4.7.1.1 First article hydrostatic test. This test shall be performed first with the joint compressed to its qualifying rated compression and then with the joint extended to its rated extension. When no extension is specified, this second test shall be made with the joint in its neutral position.

4.7.1.2 Standard production hydrostatic test. This test shall be performed with the assembly in the neutral length. If the shipping length is different from the neutral length, and extends the convoluted length of the bellows, the test shall be performed with the joint at its shipping length.

4.7.2 Cyclic endurance test. When specified (see 6.2), a cyclic endurance test shall be performed on joints selected with the number of complete cycles as specified (see 6.2). The test shall be performed under pressure at ambient temperature and the joint shall be cycled in axial movement only. During the test, the pressure in the joint shall be adjusted to simulate, as closely as possible, the maximum design conditions of the joint to be qualified. Thus, the maximum design pressure specified for the group shall be adjusted in accordance with ASME Boiler and Pressure Vessel Code, based on the ratio of the stress values for the bellows material. The pressure may vary from zero to this value during each cycle, providing the pressure reaches its maximum when the joint is compressed to its qualifying rated compression. Upon completion of the required number of cycles, each test joint shall be pressure-tested as before. If the joint fails to pass this cyclic endurance test, it shall be rejected and a new joint of improved design shall be fabricated and tested. Any change in the test joint must be reflected in the final production units.

4.7.3 Tests for pressure service. When the design pressure is equal to or larger than 15 psig the joint shall be subjected to a hydrostatic test pressure equal to 1-1/2 times the design pressure. When the design is less than 15 psig an air and soap leak test shall be performed in lieu of the hydrostatic pressure test.

4.7.4 Joints rated for vacuum service. Vacuum service assemblies shall be tested pneumatically to the rated vacuum of the expansion joint; or shall be tested pneumatically or hydrostatically at a pressure above the atmosphere equivalent to 1-1/2 times the rated vacuum.

4.7.5 Shock test. When specified (see 6.2), a shock test shall be required for joints delivered for shipboard use.

4.7.6 Other tests.

a. A magnetic particle test conforming to ASTM E709 may be specified in addition to pressure or vacuum testing (see 6.2).
b. A parallel/lateral force deflection test may be specified to verify force deflection requirements in certain critical applications such as steam or gas turbine applications (Note: This parallel/lateral test is expensive and should only be required when necessary).

4.8 First article test documentation. The manufacturer shall record and document each first article test performed. This documentation shall be available to the government contracting officer (see 6.2.1). Documentation shall include, but is not limited to the following:

a. The drawing number of the expansion joint.
b. Mill test reports of materials used in the joint.
c. Hydrostatic test pressure.
d. The qualifying rated compression, extension, lateral offset, or angular rotation.
e. Report of the number of complete cycles obtained.
e. Report of pressure test, or other leakage test performed after completion of the cyclic endurance test.
g. The adjusted internal pressure during the cyclic endurance test.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's of Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The bellows expansion joints covered by this specification are intended for steam, water, oil, or gas piping services which require the absorption of movement resulting from the thermal expansion of piping or other factors.

6.1.1 Types of joints. The types of bellows expansion joints listed under 1.2 are basic constructions. Arrangements of this basic type vary with the individual requirements of each application. The most common arrangement is one, which absorbs axial movements. Joints of this type are sometimes suitable for the absorption of small amounts of lateral deflection. Movement other than axial motion, can be absorbed by expansion joints of special arrangement as indicated by the following examples:

a. Hinged expansion joint – An expansion joint designed to permit angular rotation in one plane only by the use of a pair of pins through hinge plates attached to the expansion joint ends.
b. Gimbal expansion joint – An expansion joint designed to permit angular rotation in any plane by use of two pairs of hinges affixed to a common floating gimbal ring.
c. Universal expansion joint – An expansion joint containing two bellows joined by a common connector for the purpose of absorbing any combination of the three basic movements, i.e., axial movement, lateral deflection, and angular rotation.
d. Swing expansion joint – An expansion joint designed to absorb lateral deflection and angular rotation in one plane only by the use of a pair of swing bars.
e. Pressure-balanced expansion joint – An expansion joint designed to absorb axial movement and lateral deflection while absorbing the pressure thrust by means of tie devices interconnecting the flow bellows with an opposed bellows also subjected to line pressure.

6.1.2 Pressure. Copper alloy expansion joints should be restricted to the pressure conditions specified in 3.7.1. Type I expansion joints (except copper (see 3.7.1)) are commonly limited to low-pressure services, with the upper limit being between 30 and 100 psig working pressure depending on size and the specific design. Type II and III expansion joints (except copper (see 3.7.1)) are suitable for medium and higher pressures. All types are suitable for vacuum service.

6.1.3 Sizes. Expansion joints are custom engineered and fabricated for specified applications. Because there are infinite number of sizes that might be required for use in piping systems which include both standard and nonstandard sizes, specific sizes are not cited in the classification section 1.2.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. End connections (see 3.6.4).
c. If "Van Stone" facings are required and size of material and pressure class (see 3.6.4).
d. Whether limit stops are to be provided (see 3.6.5).
e. Guides, if required (see 3.6.7).
f. Flow liners and material, if required (see 3.6.8).
g. Base, if required, for class 4 expansion joints, or if not required for class 2 expansion joints, and if base is suitable as an end anchor (see 3.6.9).
h. Drain connection, type, and preparation (see 3.6.10).
i. Shrouds, if required (see 3.6.12).
j. When a cyclic endurance test is required for first article and production units and the number of complete cycles required (see 4.7.2).
k. Shock test if required (see 4.7.5).
l. Other tests if required (see 4.7.6).
m. Packaging (see 5.1).

6.2.1 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements are developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When provisions of DoD Federal Acquisition Regulations (FAR) Supplement, Part 27, Sub-Part 27.475-1 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data should be delivered by the contractor in accordance with the contract or order requirements (see 4.8).

6.3 Performance. The following pertain to 3.6 and the following:

a. Bellows expansion joint design is dependent upon several variable conditions under which the joint is intended to operate. It is therefore imperative that all applicable conditions under which the joint is to operate be specified in the acquisition documents.

b. The type and degree of motion which the joint is required to absorb (see 3.5.1) is specified separately from the requirement for extra traverse motion (see 3.5.1.1). It is suggested that expansion joints are specified to be suitable for 25 percent more movement than the calculated expansion of the piping. The type and amount of motion can be specified directly, but a dimensioned and labeled sketch or drawing of the piping layout is generally preferred by the manufacturer to permit the manufacturer to recommend anchorage, guidance, alignment requirements, and other recommendations for the specific application.

c. The life of a bellows expansion joint depends upon several variables of which the following are a few examples: thickness of bellows material, size of the bellows, number of corrugations, amount of motion, frequency of motion, temperature and pressure conditions. Therefore, no life expectancy can be generally specified for all types of joints. The life requirement is best specified by the number of complete cycles of movement which is anticipated for the period the joint should last. This would be determined by the number of times the service would be shut down over the required period, or by the number of times the temperature would vary between certain limits during the period. Vibrational movement should be specified by amplitude and frequency, as flexural stresses in the bellows under vibration should be within the proportional limit of the material used. Cyclic endurance proof tests are expensive since the joint under test is not suitable for use after the test. Such tests merely indicate suitability of design and should only be specified where critical conditions warrant the extra time and expense incurred.

6.4 Test pressure. Standards of the Expansion Joint Manufacturers Association usually test their joints at 1-1/2 times rated pressure (see 6.2j). Joints can be manufactured for test at pressures higher than 1-1/2 times the rated pressure, but to do so will usually force the design to be based on the test pressure rather than on the operating pressure. Such practice would in most cases require an increase in thickness of the bellows material and a corresponding increase in the number of corrugations to realize the cyclic endurance life. The characteristics of a particular application should govern the decision to alter the test pressure requirements specified in 6.2.

6.5 First article. When a first article inspection is required, the item will be tested and should be a first production item or it may be a standard production item from the contractor's current inventory as specified in 4.1. The first article should consist of one expansion joint. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examination, test, and approval of first article.

6.6 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. Table II lists the Environmental Protection Agency (EPA) to seventeen hazardous materials targeted for major usage reduction. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see section 3).

TABLE II. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and Compounds	Lead and Compounds	Toluene
Carbon Tetrachloride	Mercury and Compounds	1,1,1 – Trichoroethane
Chloroform	Methyl Ethyl Ketone	Trichloroethylene
Chromium and Compounds	Methyl Isobutyl Ketone	Xylenes
Cyanide and Compounds	Nickel and Compounds	

6.7 Guidance on use of alternative parts with less hazardous or nonhazardous materials. This specification provides for a number of alternative plating materials via the PIN. Users should select the PIN with the less hazardous material that meets the form, fit and function requirements of their application.

6.8 Subject term (key word) listing).

Axial movement
Diaphragm
Corrugations
Rings
Sleeves
Valves, drain

6.9 Changes for previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensive change.

CONCLUDING MATERIAL

Custodians:
Army – AT
Navy – SH
Air Force - 99
DLA – CC

Preparing activity:
DLA - CC

(Project 4730-2188-000)

Review activities:
Army - CE
Navy – MC, SA
Air Force – 71

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://www.dodssp.daps.mil.